

WHAT IS CLAIMED IS:

1. A plasma processing system, comprising:  
  
a chamber configured to contain a plasma and including a chuck within an interior area of the chamber, the chuck including a support surface and a bottom surface;  
  
a first voltage-current probe positioned at a first position located exterior to the chamber and on a radio-frequency transmission line between the chamber and a power source; and  
  
a simulation module connected to the first voltage-current probe and arranged to solve, based on measurements transmitted from the first voltage-current probe, a radio-frequency model of the radio-frequency transmission line between the first position and a second position located within the chamber.
2. The plasma processing system of Claim 1, wherein the simulation module is further arranged to calculate a load radio-frequency impedance at the second position based on the solved radio-frequency model.
3. The plasma processing system of Claim 1, wherein the second position is located at a boundary between the plasma contained in the chamber and a first interior surface of the chamber.

4. The plasma processing system of Claim 3, wherein the chuck is positioned on a second interior surface of the chamber, the second interior surface being an opposite side of the first interior surface.

5. The plasma processing system of Claim 1, wherein the support surface is located between the bottom surface and the first voltage-current probe.

6. The plasma processing system of Claim 1, wherein the second position is located at the support surface.

7. The plasma processing system of Claim 6, wherein the bottom surface is located between the support surface and the first voltage-current probe.

8. The plasma processing system of Claim 1, further comprising a second voltage-current probe positioned at a third position located exterior to the chamber and on an opposite side of the chamber relative to the first voltage-current probe.

9. The plasma processing system of Claim 1, further comprising an antenna positioned within the chamber and configured to excite the interior area of the chamber at varying frequencies.

10. A plasma processing system, comprising:

a chamber configured to contain a plasma;

a probe arranged to measure at least one of voltage and current, and positioned at a first position located exterior to the chamber and on a radio-frequency transmission line between the chamber and a power source; and

means for receiving measurements from the probe, for solving a radio-frequency model of the radio-frequency transmission line between the first position and a second position located within the chamber based on the received measurements, and for calculating a load radio-frequency impedance based on the solved radio-frequency model.

11. A method for determining a load impedance in a chamber, comprising:

providing a transmission line between a power source and the chamber;

measuring at least one of voltage and current at a first position located exterior to the chamber and on the transmission line;

solving a model of the transmission line between the first position and a second position located within the chamber based on results of the measuring step; and

calculating the load impedance at the second position based on the solved model.

12. The method of Claim 11, further comprising:

creating a plasma within the chamber.

13. The method of Claim 12, wherein the second position is located at a boundary between the created plasma and an interior surface of the chamber.

14. The method of Claim 11, further comprising:

exciting an interior area of the chamber at varying frequencies.

15. The method of Claim 11, further comprising using an equivalent circuit to represent at least a portion of the transmission line.

16. The method of Claim 15, wherein said using an equivalent circuit comprises using at least one of a T-network, an L-network and a  $\Pi$  network to represent at least a portion of the transmission line.

17. The method of Claim 16, wherein said using an equivalent circuit comprises using a T-network to represent at least a portion of the transmission line.

18. A plasma processing system comprising:

means for transmitting alternating current (AC) power from an AC power source to a processing chamber;

means for measuring at least one of voltage and current at a first position located exterior to the chamber and on the means for transmitting;

means for solving a model of the means for transmitting between the first position and a second position located within the chamber based on results of the means for measuring;  
and

means for calculating the load impedance at the second position based on the solved model.

19. A computer readable medium containing program instructions for execution on a processor, which when executed by the computer system, cause the processor to perform the steps of:

inputting a measurement of at least one of voltage and current at a first position located exterior to a chamber of a semiconductor processing system and on a transmission line provided between a power source and the chamber;

solving a model of the transmission line between the first position and a second position located within the chamber based on the measurement of a transmission line; and

calculating the load impedance at the second position based on the solved model.